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AUTHOR Seymour, Sherrie L.; And Others
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ABSTRACT

This study investigated the effects of medium of instruction, task difficulty, and gender on continuing motivation. A total of 139 fifth and sixth graders with previous computer experience completed an initial learning task in one of the two media formats (computer or paper/pencil) and under either a hard or easy difficulty level. Students' choice of instructional medium for a second learning task was the measure of continuing motivation. Of the 69 computer subjects, 67 (97%) chose to return to the computer, whereas only one of 70 paper/pencil subjects (1%) chose to return to the paper/pencil form, p=.0001. The remaining 69 chose the computer for the second task. Questionnaire data indicated that computer subjects also evaluated their own performance significantly more highly, reported the task to be significantly more interesting and easier, and had a greater desire to study more of the same type of subject matter. A list of references, two data tables, and questionnaire items and responses are included. (Author/JB)

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Microcomputers and Continuing Motivation

Sherrie L. Seymour and Howard J. Sullivan

Department of Educational Technology

Arizona State University

Naomi O. Story and Mary Lou Mosley

Maricopa Colleges, Phoenix, Arizona

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Abstract

This study investigated the effects of medium of instruction, task difficulty, and gender on continuing motivation. A total of 139 fifth and sixth graders with previous computer experience completed an initial learning task in one of the two media formats (computer or paper/pencil) and under either a hard or easy difficulty level. Subjects' choice of instructional medium for a second learning task was the measure of continuing motivation. Sixty-seven of the 69 computer subjects (97 percent) chose to return to the computer, whereas only one of 70 paper/pencil subjects (one percent) chose to return to the paper/pencil form, $p<.0001$. The remaining 69 chose the computer for the second task. Questionnaire data indicated that computer subjects also evaluated their own performance significantly more highly, reported the task to be significantly more interesting and easier, and had a greater desire to study more of the same type of subject matter.

MICROCOMPUTERS AND CONTINUING MOTIVATION

Microcomputers are rapidly becoming an important medium of instruction. Research on computer-assisted instruction (CAI) has often focused on student learning through comparisons of several teaching methods (Clark, 1983; Jamison, Suppes, & Wells, 1974). Some evidence exists that CAI may be more effective than traditional teaching methods (Bell, 1983; Kulik, 1983; White, 1983). However, Clark (1983) suggests that the causal comparisons between CAI and achievement are confounded by the uncontrolled effects of novelty and instructional method. Indeed, until recently relatively little attention had been given to how strong student motivation is to use computers and to continue to use them under various conditions. Like student achievement, willingness to return to computer-based learning tasks is also an important consideration related to the effects of computers.

The role of motivation in CAI is becoming a more prominent topic in the professional literature. Swenson and Anderson (1982) state that the motivational reinforcement of CAI is perhaps its strongest asset. The format of CAI has been looked at for clues on motivating characteristics which aid learning (Dence, 1980; Malone, 1980). Roblyer (1985) noted that the motivation behind the improvement of attitudes toward subject matter in the CAI format is often attributed to the computer itself.

Research is far from definitive on the extent to which microcomputers motivate students and the conditions that maximize the motivation. The effectiveness of CAI has been attributed in part to a novelty factor (Grimm, 1978; Kulik, Bangert, & Williams, 1983). However, neither Kulik, Kulik, & Cohen (1980) nor White (1983) found evidence for a novelty effect in their reviews of computer use. Computer experience has been found to be a major factor in computer attitudes (Enochs, 1984; Loyd and Gressard, 1984). The motivational effects of CAI have also been examined from a number of other standpoints, including retention, feedback, learner control, and individualization (Dence, 1980; Roblyer, 1985).

A considerable body of recent research has centered on continuing motivation (McCombs, 1984), which generally has been defined as the free choice to return to a previous learning task instead of an alternative task. The difficulty level of the original task and the gender of the learners are two factors that have been found to be associated with continuing motivation.

Task difficulty is well established as a factor that

influences motivation (Lepper, 1985; Story & Sullivan, 1985). Return to task, as the measure of continuing motivation, has been found to be significantly higher when subjects initially perform an easy task rather than a hard one (Harter, 1975b; Hughes, Sullivan, & Mosley, 1985; Pittman, Emery, & Boggiano, 1982). Task difficulty has also been found to interact with subject gender. Boys tend to return more frequently to challenging tasks and girls to easier ones (Harter, 1975a,b; Wigfield, 1984). Whether these findings on continuing motivation as it relates to task difficulty and gender extend to computer-assisted learning tasks has not been investigated experimentally.

A recent study by Mosley, Haas, & Story (1984) suggests that the use of the computer itself may be a strong factor in promoting continuing motivation. These researchers studied the motivation of sixth grade students for tasks of differing difficulty levels as presented exclusively by microcomputer. The overall return-to-task rate on the computer-based task was far higher than return rates in two previous continuing motivation studies (Hughes, Sullivan, & Mosley, 1985; Mosley, 1983) using learning tasks presented only in paper/pencil format.

The present study was conducted to investigate experimentally the relationship to continuing motivation of instructional medium, task difficulty, and sex of subject. Two types of media, computer and paper/pencil, were crossed with two levels of difficulty, hard and easy. The measure of continuing motivation was student choice of instructional medium for a second learning task after they had completed an initial task either on a microcomputer or in paper/pencil form. Student attitudes related to the two media were also assessed.

Method

Subjects

The subjects were 139 fifth and sixth grade students from six classes in a suburban school located in a middle-class socioeconomic area. All were familiar with computers and the school computer lab where the research was conducted.

Materials

The experimental materials were two sections from the Grade 5-6 "Power Switch" unit from the (Energy Source Program, 1984). For this study, two separate sets of

eight questions each, one set to be answered at the end of each of two sections, were adapted from questions in the original unit. The questions were prepared in paper/pencil form for the paper/pencil group and were put on floppy disks for the computer group. The format of the questions was the same on the computer screen as on paper. Feedback was included after every item on the computer, as is normal in CAI, and after each set of 8 items for the paper/ pencil group.

The easy/hard variation in task difficulty was achieved by manipulating the difficulty level of the questions. The questions in the easy version were three-choice multiple choice items. Those in the hard version were completion items which required subjects to recall the correct answer and write it in. The multiple-choice and completion items covered identical content. A preliminary tryout with one Grade 5 class and one Grade 6 class indicated that the two versions did indeed vary in difficulty level. Students averaged 43% on the hard version and 74% on the easy version.

Procedures

Boys and girls were randomly assigned to one of the treatment groups, computer or paper/pencil, and to either the hard or easy difficulty levels. Except for their assigned medium, the procedures were the same for the computer and paper/pencil groups.

In both treatments, the text was read aloud by students who were previously identified by the teacher as good readers. The other students followed along. At the end of the first section, subjects answered the first set of questions on their own in their assigned paper/pencil or computer medium. Subjects then read the second section and answered the questions over it in the same manner. After finishing these questions, all subjects completed a six-item questionnaire on which they marked their choice of medium (computer or paper/pencil) for a possible second learning task and indicated their perceptions of the initial task.

Data Sources

The proportion of subjects who chose to return to the same medium for the second task served as the measure of continuing motivation. Other data on student attitudes were obtained from the follow-up questionnaire items dealing with perceived performance, student interest, task difficulty, and desire for further study about energy.

Design and Data Analysis

The experimental design was 2 (medium) x 2 (difficulty) x 2 (gender) completely crossed factorial design. Data were analyzed by analysis of variance for return to task and by chi-square for the questionnaire items.

Results

Return to Task

The frequency of subjects returning to task by treatment and gender is shown in Table 1. The 2 x 2 x 2 ANOVA yielded a highly significant effect for medium,

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Insert Table 1 about here

$F(1,137) = 1488.32$, $p<.0001$. Sixty-seven of 69 subjects (97 percent) in the computer treatment chose to return to the computer for a second learning task. In contrast, only one of the 70 (one percent) in the paper/pencil version chose paper/pencil for the later task. The other 69 paper/pencil subjects preferred the computer for the second task.

The effect for instructional medium was so powerful that it left little room for possible effects for task difficulty and gender. Nearly all subjects at both difficulty levels and of both sexes chose the computer as the medium for a future task. Of the three who did not, one male and one female were initially in the hard difficulty level for the computer group and one female was in the hard level of the paper/pencil group.

Student Attitudes

Attitudes of students in each group, as indicated by their responses on the follow-up questionnaire, are shown in Table 2. As shown in the table, significant

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Insert Table 2 about here

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differences favoring the computer group over paper/pencil subjects were found on all five items. Summing of the first two columns for items 1-3 reveals that more students in the computer group thought that they did well on the activity (85 percent to 69 for paper/pencil), that the activity was interesting (96 percent to 81), and that the activity was easy (80 percent to 47). More computer than paper/pencil subjects also reported that they would rather study energy again than another subject (29 percent to 14) and that they would rather do another energy lesson than not do another lesson at all (87 percent to 64 percent).

En Route Performance

Mean scores for performance on the 16 en route practice items were also calculated for the two treatment groups. The overall means were very similar for the two groups--7.72 items correct for paper/pencil and 7.64 correct for computer subjects.

Total time on task was approximately 45 minutes for both the computer and paper/pencil subjects and did not differ significantly between the two groups.

Discussion

The present study was conducted to investigate the effects of medium of instructional practice and task difficulty on the continuing motivation of boys and girls. Results indicated an extremely strong preference for further instructional practice on the microcomputer over a paper/pencil format. This effect was so strong that it left room for only slight variations related to task difficulty and subject gender. Questionnaire responses of subjects also revealed much more favorable attitudes toward the computer than paper/pencil.

The most profound finding was the strong motivational effect of the computer as indicated by the fact that 67 of 69 students (97 percent) in the computer group and 69 of 70 (99 percent) in the paper/pencil group chose the computer for their second learning task. Though microcomputers have been cited as having high motivational value (Lepper, 1985; White, 1983), the overwhelming preference demonstrated by subjects in this study was certainly unexpected. Preference for the computer was nearly unanimous whether students did the initial task on the computer or in paper/pencil format. This powerful preference occurred even though students in the computer group did not perform any better on the en route practice items for the learning task than did those in the

paper/pencil group.

Another strong finding was the important positive effect the computer had on student attitudes. The more positive attitudes revealed by the questionnaire responses complement the return-to-task data. Certainly interest is an important component of motivation (Hawkins, 1984; Maehr, 1976; Malone, 1980). Subjects in the computer group rated the learning as more interesting than those in the paper/pencil treatment, even though the substance of the activity was the same for both groups. Similarly, more subjects in the computer group thought that they did well on the activity and that it was easy. Yet, these impressions were not substantiated by the performance data for the task--the two groups performed almost equally well on the practice items, with a very slight, nonsignificant difference favoring paper/pencil subjects. That is, since the computer group did not in fact outperform the paper/pencil group, merely doing the task on the computer apparently resulted in their thinking that they did well and that it was easier.

The positive attitudes associated with the computer as a medium of instruction also generalized to the subject matter itself. A significantly greater number of subjects in the computer group than in the paper/pencil group reported a preference for studying energy again over studying some other subject matter and over not doing another activity at all. That use of the computer to study particular subject matter could increase students' interest in that subject-matter area is potentially an important finding. It would be especially valuable if students could maintain the increased subject-matter interest on a long-term basis and if they were motivated toward more independent study of the subject-matter area.

The strength of the motivational and attitudinal effects associated with the computer were surprising in that it was intentionally used only as a substitute for the paper/pencil medium. To keep other conditions highly similar across the two presentation media, no other capabilities such as special graphics or personalized or interactive feedback were incorporated into the computer treatment. The results produced by the computer under these constraints suggest that instructional applications that capitalize on its special capabilities (Sawyer, 1985) may further complement its motivational potential.

Although this study was designed to deal with student motivation, it also yielded data on <u>en route</u> performance on the learning task. In contrast with the motivational and attitudinal data, the performance scores of the computer and paper/pencil groups were virtually identical.

Thus, there was no evidence that the more positive attitudes of the computer group or their item-by-item feedback had an effect on their achievement on the learning task. This finding is consistent with Clark's (1983) contention that different presentation media per se do not directly affect student learning when the other elements of the instruction are the same across the two or more media.

The medium of instruction was so much more powerful a variable than either subject gender or task difficulty that no meaningful conclusions can be drawn from this study about the relationship of the latter two variables to continuing motivation. The overwhelming preference for the computer washed out any differences that might have occurred for gender or task difficulty under other conditions. This preference was nearly unanimous among both females and males and across both the hard and easy difficulty levels.

The present findings clearly reveal that microcomputers potentially have strong positive motivational and attitudinal effects in the classroom. Still, considerable caution should be exercised in generalizing too freely from these results to long-term classroom practice because this study measured only immediate effects from a one-session experiment. The novelty effect often associated with computers might have been a factor in the present results, but any such effect may have been reduced by the fact that the subjects were experienced with computers. Overall, the positive results favoring the computer group were so strong and consistent that it seems highly probable that they were due primarily to the appeal of the computer itself and only secondarily, if at all, to other factors.

A worthwhile area for further research is the study of effects of microcomputers when they are used as the primary medium of instruction with a program over an extended time period. Would students continue to show the strong preference for the computer that they demonstrated in this study, or would it lose much of its appeal over time? Student interest in the subject matter itself and student achievement would also be important factors to investigate in such longer-range studies. Research on the effects of microcomputers over an extended period should help us better understand their most productive uses in promoting student motivation and achievement in the classroom.

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Table 1

Frequency of Return by Medium of Instruction, Gender, and Task Difficulty[1]

	Computer Practice			Paper/Pencil Practice		
	Female	Male	Total	Female	Male	Total
Hard	17/18 (94%)	18/19 (95%)	35/37 (95%)	1/19 (5%)	0/15 (0%)	1/34 (3%)
Easy	18/18 (100%)	14/14 (100%)	32/32 (100%)	0/15 (0%)	0/21 (0%)	0/36 (0%)
Total	35/36 (97%)	32/33 (97%)	67/69 (97%)	1/34 (3%)	0/36 (0%)	1/70 (1%)

1 The cell entries represent the number of students out of the total cell number who chose to return to the same medium for the second task. For example, 17 of the 18 female students (94%) on the computer version of the hard task chose the computer for the second task. In contrast, only one of 19 female students (5%) in the paper/pencil version chose to return to it. The other 18 chose the computer version for the second task.

Table 2

Questionnaire Responses by Treatment

Questionnaire Items and Responses — χ^2 & p level

What do you think?

1. On this activity, I think I did:

	very well	well	badly	very badly	$\chi^2(3) = 10.751$ p <.02
Computer	36%	49%	12%	3%	
Paper/Pencil	17%	52%	17%	14%	

2. I thought this activity was:

	very interesting	interesting	boring	very boring	$\chi^2(3) = 10.417$ p <.02
Computer	57%	39%	3%	1%	
Paper/Pencil	34%	47%	13%	6%	

3. I thought this activity was:

	very easy	easy	hard	very hard	$\chi^2(3) = 17.888$ p <.0005
Computer	19%	61%	17%	3%	
Paper/Pencil	17%	30%	40%	13%	

If we return to do more activities with you, what would you prefer?

4. (a) study energy again: (b) study some other subject:

Computer = 29%	Computer = 71%	$\chi^2(1) = 4.259$ p <.05
Paper/Pencil = 14%	Paper/Pencil = 86%	

5. (a) do another energy lesson: (b) not do another lesson at all:

Computer = 87%	Computer = 13%	$\chi^2(1) = 9.991$ p <.002
Paper/Pencil = 64%	Paper/Pencil = 36%	